CURRENT DESIGN REQUIREMENTS FOR CORROSION CONTROL ON HELICOPTERS

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Aeronautical Design Standard ADS-13C embodies the general requirements for the materials and processes utilized in the design and construction of Army aircraft. The materials and processes are utilized in accordance with AMCP706-203, the Engineering Design Handbook Helicopter Engineering, part three, Qualification Assurance. The properties of materials are generally obtained from MIL-HDBK-5, MIL-HDBK-17 and MIL-HDBK-23, for metallic materials, plastics, and structural sandwich composites respectively. All of the system parts are finished to provide protection from corrosion and other forms of material deterioration in accordance with a contractor-prepared and Government-approved material deterioration prevention and control (MADPAC) plan which is detailed in the appendix to ADS-13. This appendix describes the managerial and technical responsibilities of Army contractors in the design, validation, development and production phases of Army aviation systems. It provides a mechanism for the implementation of sound materials selection practices and finish treatments during the life cycle of all Army aviation weapon systems and defines the organization and implementation of a MADPAC finish specification which complies with MIL-F-7179. ADS-13C represents the most recent revision of the standard which embodies some of the corrosion lessons learned from Army helicopters where weight reduction was the overriding concern in the design and construction of the aircraft.

Introduction

U.S. Army equipment has suffered enough out-of-service costs due to corrosion that today three principles on heading off corrosion can be said to be generally accepted. First, corrosion control must be built into original equipment design. Second, an awareness of the need for corrosion prevention must be maintained throughout manufacturing. Third, lessons learned on corrosion during design, development, production and fielding of equipment must be fed back to the start of any new designs. However, when a number of organizations not all under the same management are involved in the design-to-fielding process, creating the needed information flow is a problem by itself. It is the intent of this paper to describe the control mechanism now being used in support of future Army aircraft development. Within the controlling documents one can find details of current design requirements for corrosion control on helicopters.

Approach

Steps taken in establishing the needed control mechanism were to first recognize principle organizations or organizational sub-units in the information process and then to tie them together with appropriate regulations and contracts which assigned responsibilities. A schematic of the information flow loop for any type of Army equipment is shown in Figure 1. In this loop the command element responsible for development of all systems of a particular type is both an information collection and dissemination agency generally working closely with project managers and contractors on specific systems and with repair elements to get field experience. Project managers prepare contracts for new system development and assign responsibilities to the contractor.

Since there is no single approach, so far, to dealing with corrosion control on a wide variety of equipment, regulations allow a development command and subsequently a project manager to tighten controls, as necessary. To avoid misunderstandings, regulations also provide a statement of purpose. Developing commands and managers, in turn, provide contractors with specific guidelines.

Results

In September 1982, the U.S. Army Aviation Research and Development Command (AVRADCOM) released Aeronautical Design Standard 13C, covering general requirements for materials and processes involved in the design and construction of Army aircraft. A copy of the document is included with this paper. As noted in Figure 2 general requirements on materials and materials processes relate to Chapter 6 of the Engineering Design Handbook, Helicopter Engineering (Part Three-Qualification Assurance) while needs for engineering data are referred to the appropriate Military Handbooks for Metals, Plastics, and Structural Sandwich Composites. Most significantly, corrosion control is covered by a full appendix to ADS-13C itself.

Figure 3 shows that Appendix I to ADS-13C establishes contractual requirements for a Materiel Deterioration Prevention and Control (MADPAC) program for Army aviation weapon systems. The broader requirement on the development command is Regulation 702-24 from Headquarters U.S. Army Materiel Development and Readiness Command. A copy of this regulation is also included with this paper.

Project managers will now use ADS-13C in establishing contractual requirements for design, development and production of specific aircraft systems, thereby passing along the intent of minimizing life cycle cost due to corrosion. Figure 3 also shows that dialogue is intended between the contractor and the development command with the command having approval authority on a contractor's response to ADS-13C. A final important point in the figure is that contractual requirements are not limited to the new aircraft but are extended to cover spare parts and components.

With these two documents, responsibilities have been assigned to all principle organizations, the intent of the materiel deterioration prevention program has been established and specific guidelines on materials, processes, and practices have been publicized.

What then is required of the contractor? Figure 4 lists three basic requirements: the MADPAC Plan, a Finish Specification, and a System Technical Order for maintenance. Key parts of each requirement are also noted. It is important to note that both administrative and technical requirements are being detailed here for the contractor and that specific provision is made for the contractor and development command to work together in meeting these requirements. Thus, there is a continuing opportunity to introduce the most recent lessons learned.

It is also important to note that while corrosion prevention is the central theme of Appendix I to ADS-13C, the overall topic is materiel deterioration. There is sufficient room in these documents and their intent is to include all current and future organic base materials as well as metals.

Lessons Learned

Sufficient details on materials and materials processes are given in ADS-13C and Regulation 702-24 that they need not be repeated here. These details represent guidance to contractors based on past experience. More recent lessons learned are given in Figure 5. These lessons are similar to experiences gained by the U.S. Navy and U.S. Air Force on similar aircraft.

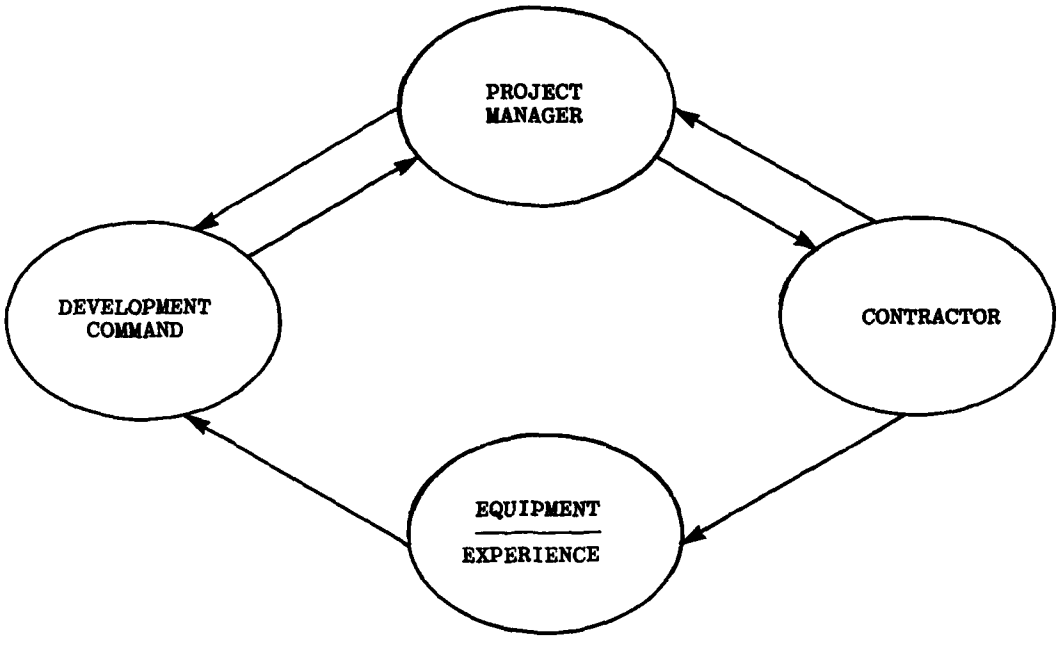

FIGURE 1

FROM
AERONAUTICAL DESIGN STANDARD
ADS-13C

- All Materials and Materials Processes in accordance with Ch. 6 of AMCP 706-203
- Materials Properties for Design Mil-Hdbk-5, -17, -23
- Corrosion Protection in accordance with Materiel Deterioration Prevention and Control Plan in Appendix I to ADS-13C

FIGURE 2

APPENDIX I TO ADS-13C

- PURPOSE: Specify contractual requirements for a Materiel Deterioration Prevention and Control Program for Army Aviation Weapon Systems.
- INTENT: Fulfill objective of minimizing Life Cycle Cost due to Corrosion.
- APPLICATION: Used in conjunction with ADS-13C by AVRADCOM and contractors in design and procurement. Includes spare parts and *components*.

FIGURE 3

MATERIEL DETERIORATION PREVENTION
CONTRACTUAL REQUIREMENTS

I. MADPAC PLAN:

- Contractor establish Plan during Design, Development, Validation, Production
- Complete description of design efforts
- Selection of Materials and Production Processes
- Delineation of applicable finishes
- Test Program to establish effectiveness

II. PLAN INCLUDES:

- Designation of responsible organizational element
- Establishment of Materials Review effort between AVRADCOM and Contractor
- Evaluation of Manufacturing Processes and Materials Treatments

  Consider Hazards of:

  Stress Corrosion Cracking
  Hydrogen Embrittlement
  Galvanic Corrosion
  Corrosion Fatigue
  Fretting Corrosion
  Erosion Corrosion
  Pitting Corrosion
  Selective Leaching

- Review evaluation of protective finishes and coatings for specific system prior to use
- Provision for consultation between corrosion engineers and systems engineers - close liaison between Army and contractor professionals

III. FINISH SPECIFICATION:

- Prepared by Contractor in accordance with Mil-F-7179
- Referenced on drawings

IV. SYSTEM TECHNICAL ORDER:

- Explain procedures for corrosion control and maintenance
- Used by personnel in organizational intermediate and depot levels
- Prepared in accordance with Mil-M-38795

FIGURE 4

RECENT LESSONS LEARNED

- Exclude water from any interior space
- Drain all water traps and fill small cavities too small to drain properly
- Use wet assembly on all exterior fasteners
- Seal all mating surfaces
- Eliminate Nickel Plating on electrical connectors

FIGURE 5